

**A CHECK-LIST OF THE *COCCONEIS* SPECIES  
(BACILLARIOPHYCEAE)  
IN ANTARCTIC AND SUBANTARCTIC AREAS,  
WITH SPECIAL FOCUS ON KERGUELEN ISLANDS.**

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**ABSTRACT** - The high diversity and abundance of the genus *Cocconeis* in subtidal marine sediments in the Kerguelen area, especially under the *Macrocystis* canopy, prompted a bibliographic review concerning this genus in Antarctic and Subantarctic areas. The major oceanographic expeditions favoured the discovery and description of numerous new species and varieties, but also a lot of dubious taxa: of the 38 new taxa mentioned, only 23 were recognized as valid by VanLandingham (1968). A few species, or their synonyms, are regularly mentioned by authors and may characterize these Southern polar habitats, the others seem to be rare or geographically restricted. Freshwater species are also listed.

**RÉSUMÉ** - La très grande diversité du genre *Cocconeis* (Bacillariophyceae) dans les sédiments subtidaux marins de Kerguelen ainsi que l'abondance numérique de ces diatomées ont amené à effectuer une revue bibliographique de ce genre en zones Antarctiques et Subantarctiques. Les premières grandes expéditions océanographiques permirent la découverte et la description de très nombreuses espèces et variétés mais également de nombreux taxons douteux: sur les 38 taxons mentionnés comme nouveaux dans cette revue, seulement 23 sont considérés comme étant valides par VanLandingham (1968). Quelques espèces ou leurs synonymes, régulièrement mentionnés par les auteurs, caractérisent ces zones polaires; les autres espèces sont rares ou ont une répartition géographique limitée. Les espèces d'eau douce sont également mentionnées.

**Keywords** - Southern Polar *Cocconeis*, Kerguelen, review.

## INTRODUCTION

Preliminary studies on marine microphytobenthos from various sediments of the Kerguelen Islands, in relation to the algal pigment diversity (Klein & Riaux-Gobin 1991), bear witness to the great richness of these diatom assemblages. On subtidal sediments under the *Macrocystis* canopy, the genus *Cocconeis* is particularly well represented. However, some are very small and difficult to identify (Riaux-Gobin, 1992, 1993; Riaux-Gobin & Compère, *in prep.*). In addition to the fact that it is difficult to obtain the oldest documents and those of limited distribution (De Toni,

1891-94; Karsten, 1905 or Larson, 1974 in Prescott, 1979), bibliographic references mention species that are presently recognized as synonyms, or moreover that have been assigned to other genera. Incomplete descriptions or drawings which are too simplistic make some comparisons difficult. Some recent authors still use older synonyms or still separate two forms or varieties that are regrouped by VanLandingham (1968-1979).

All these taxonomic difficulties prompted the present synthesis of published work on the genus *Cocconeis* (marine and fresh water); special attention is paid to the species discovered or encountered during the major oceanographic expeditions (Table I-IV). Comments are added when changes to the names have subsequently occurred. Special focus is given to species mentioned by authors as pertaining to the diatom flora of the Kerguelen Islands. The nomenclature set up by VanLandingham (1968-1979) has been followed here to standardize all the names used successively by authors for a given taxa (keeping in mind that this author is not specialized on the *Cocconeis* species).

Northern polar regions are not included here, in spite of the interest of pointing out differences between the floras and distinguishing species which are ubiquitous, cold adapted and / or geographically restricted.

## RESULTS AND DISCUSSION

Some authors, such as Van Heurck (1909), Peragallo (1921) and Heiden & Kolbe (1928), have contributed more than others to the discovery and description of the Southern diatom species (Tables I-IV). On the other hand, Castracane (1886), working particularly on marine muds from Kerguelen, did not mention *Cocconeis*; however, Heiden & Kolbe (1928) working on samples from several Southern areas (particularly Kerguelen and the St Paul Islands) mentioned 48 taxa (including 4 new taxa, 3 of which were from Kerguelen). The oldest works seem to be far from exhaustive perhaps because the samples were not taken specifically for diatom investigation (deep mud, sludge samples for sedimentology and not adapted to the observation of real microphytobenthic assemblages); this may explain why most of the works (Table I-II) mention only a few species. Furthermore, less importance was perhaps given to common and ubiquitous diatoms so that new species were proportionally abundant (Van Heurck, 1909: 10 taxa mentioned of which 8 were new; Peragallo, 1921: 22, 6 new; Peragallo, 1924: 21, 2 new; Heiden & Kolbe, 1928: 47, 4 new).

Van Heurck (1909) carried out a recollection and a comparison with previous works, particularly 10 works from Antarctic areas (plankton, ice and coastal samples; see Table I-II); 35 *Cocconeis* taxa were mentioned, of which 15 are not accepted by VanLandingham (1968). More recently Prescott (1979) established a check-list of freshwater taxa reported up to 1977 (17 *Cocconeis* taxa). The present work is a continuation of these approaches, but restricted to the *Cocconeis* genus.

Since the earliest descriptions, a great deal of changes have occurred: some taxa described as *Cocconeis* have now been returned to other genera (they are not incorporated in the Tables since they are not referred as in the VanLandingham nomenclature, 1968): for example *C. regalis* Greville (O'Meara, 1875) became *Campyloneis grevillei* var. *regalis* (Greville) Cleve; *C. wrightii* O'Meara (Petit, 1888)

became *Mastogloia barbadensis* (Greville) Cleve (present in Kerguelen, pers. obs.); *C. splendida* Gregory (Petit, 1888) became *Mastogloia splendida* (Gregory) Cleve; *C. coelata* Walker-Arnot (Petit, 1877) became *Diploneis campylodiscus* (Grunow) Cleve. *C. glacialis* Cleve was later described as *Navicula kerguelensis* (in Castracane, 1886) and then *Navicula glacialis* (Cleve) Grunow. More recently *C. kerguelensis* Manguin (in Bourrelly & Manguin, 1954) mentioned by Hirano (1965, in Prescott, 1979) and Larson (1974, in Prescott, 1979) has been transferred to *Achnanthes saxonica* Krasske (Le Cohu & Maillard, 1983), and became *A. oblongella* Ostrup (Krammer & Lange-Bertalot, 1991). *C. sancti-pauli* has been transferred to *Achnanthes* as *A. sancti-pauli* (Heiden) Kobayasi & Sawatari (1986).

Difficulties with species determinations arise due to the distinction by different authors of two synonyms of the same species (*sensu* VanLandingham nomenclature): Heiden & Kolbe (1928) and Hustedt (1958) mentioned *C. costata* var. *pacifica* along with *C. imperatrix* that are regrouped by VanLandingham as *C. fasciolata* (Ehr.) Brown. Fukushima (1965), working in South Georgia, also mentioned *C. imperatrix*. More recently Zhu (1989) mentioned *C. costata* var. *pacifica* along with *C. fasciolata*. Even more surprisingly: Gilbert (1991) mentioned *C. fasciolata* along with *C. imperatrix*. Therefore, and in contradiction with Brown (1920), *C. imperatrix* and *C. costata* var. *pacifica* may, perhaps, be considered as independent taxa, differing from each other and from *C. fasciolata*. The same bibliographic difficulties exist for the distinction of some varieties of the species *C. gautieri*, *C. antiqua* and *C. schuettii*. Another problem is the validity of some varieties: for example Heiden & Kolbe (1928) mentioned *C. californica* along with *C. californica* var. *kerguelensis* (that are regrouped in the VanLandingham nomenclature), so that the validity of this variety may be reconsidered (Riaux-Gobin, 1992 and Riaux-Gobin & Compère, *in prep.*). Moreover, some species have been discovered by two authors at the same time and their descriptions are incomplete and contradictory (cf. *C. curiosa* Hustedt and *C. infirmata* Manguin, that may also have some affinities with *C. californica* var. *kerguelensis* Heiden; see remarks by Simonsen, 1992). Furthermore some species have been described and drawn but not named, for example *Cocconeis* sp. in Heiden & Kolbe (1928; description p. 584 and drawing fig. 107; Simonsen, 1992, did not mention this species).

In order to solve these taxonomic uncertainties, it will be necessary to seriously examine the types of original material (when still existing) and compare the oldest descriptions and drawings. Furthermore, studies using electron microscopy should provide valuable information, especially about the usefulness of separating, or not, some varieties.

Some species reported from the Southern Polar regions are characteristic, such as *C. imperatrix* (*C. fasciolata* in the VanLandingham nomenclature) and their synonyms (Manguin, 1960) or *C. gautieri* (Peragallo, 1921). In addition, *C. schuettii*, and *C. costata* var. *kerguelensis* are also frequently mentioned; the ubiquitous species *C. costata*, *C. pinnata* or *C. scutellum* are also regularly recorded. The other species (Tables II and IV) seem to be rare or geographically restricted. Some species seem to be restricted to the Antarctic region (*C. adeliae* Manguin, *C. antarctica* Van Heurck and also *C. schuettii* Van Heurck or *C. gautieri* Van Heurck).

Upon the diatoms from Kerguelen Islands, the fresh water diatom flora is well documented (Table IV). Many localities and different communities have been investigated (see references in Table III and also: Germain, 1937; Le Cohu, 1982 and Le Cohu & Maillard, 1986). The marine diatom flora of Kerguelen have been less studied although its species richness appears higher (see asterisks on Table II). The important contribution of Heiden & Kolbe (1928) however, is representative of only one area (Observatory Bay). Hustedt (1958) examined the stomach contents of *Euphausia* (krill) from the Kerguelen region. Van Heurck (1909) working with the "Janisch collection" from Kerguelen does not mention the origin of the samples. A recent work on the nannoplankton of Kerguelen (Hédoïn & Couté, 1992) mentioned six *Cocconeis* species (see Table I-II). Our investigations on subtidal muds under the macroalgae belts seems to be promising. Epiphytic assemblages (especially on *Macrocystis pyrifera*) will also give more information about the diversity of this genus in the Subantarctic area.

The genus *Cocconeis*, pertaining to the *Monoraphidineae*, is epiphytic, epilithic, kryptic (sea ice) or epipsammic and occasionally epipelagic. The samples from which material for the oldest descriptions mentioned here were drawn (muds of various depths, plankton samples or stomach contents of zooplankton) were often not adapted for the specific study of these diatoms. A large part of the taxa are reported by one author only, so that the question remains whether these taxa are rare, restricted to a small area, or simply inadequately sampled. Further investigations must pay attention to the sampling (for example sediments must be sampled with corers that do not disturb the interface) and also pay attention to the diversified smaller forms (nannophytobenthos, which dimensions are smaller than 20 µm).

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Table I: References of the works corresponding to the numbers quoted in Table 2.

N°	Area	Reference
	<b>Marine</b>	
1	Kerguelen	(O'Meara 1875)
2	Campbell Island & New Zeland	(Petit 1877)
3	Cap Horn	Petit 1888)
4	Subantarctic	(De Toni 1891-94; Van Heurck 1909)
5	Antarctic phytoplankton	(Karsten 1905; Van Heurck 1909)
6	Exped. "J. Charcot" (1903-1905)	(Petit 1908)
7	Exped. "Belgica" (1897-1899)	(Van Heurck 1909)
8	Kerguelen (Janisch collection)	(Van Heurck 1909)
9	Schwedische Südpolar Exped.	(Carlson 1919)
10	Adelie Land	(Brown 1920)
11	Exped. "J. Charcot" (1910)	(Peragallo 1921)
12	Exped. "J. Charcot" (1903-1905)	(Peragallo 1924)
13	Exped. "Pourquoi Pas"	(Mangin 1915)
14	Deutsche Südpolar Exped.	(Heiden & Kolbe 1928)
15	Discovery reports	(Hendey 1937).
16	Orcades del Sur, plankton	(Frenguelli 1943)
17	Heard Island	(Manguin 1954)
18	Exped. "Mundus"	(Hustedt 1958)
19	(South Am.) Antarctica	(Frenguelli & Orlando 1958)
20	Terre Adélie	(Manguin 1957, 1960)
21	Terre Adélie (Exped. "P.E. Victor")	(Frenguelli 1960)
22	Arthur Harbor	(Krebs 1983)
23	King George Island, plankton	(Ligowski 1986)
24	Deception Island, Antarctica	(Zhu 1989)
25	South Orkney Islands	(Gilbert 1991)
26	Kerguelen, nannoplankton	(Hédoin & Couté 1992)

Table II: References of *Cocconeis* in marine water Antarctic and Subantarctic areas: Species are listed following VanLandingham (1968, 1979) nomenclature.

In bold italics: valid name in VanLandingham (1968)

In brackets: species not referred to in VanLandingham (1968)

In italics: species quoted as uncertain or badly defined in VanLandingham (1968)

In italics and indented: species quoted as synonyms in VanLandingham (1968).

+ = present; O = quoted as new by the author; \* = Kerguelen Islands

? = annotation of the author

see next page →

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
<i>Cocconeis adaeae</i> Mangum																				○							
<i>C. antarctica</i> Brown										○																	
<i>C. antarctica</i> (V. Heurck) Franguelli & Orlando																			x		x				x		
<i>C. antiqua</i> Tempère & Brun															x										x		
<i>C. antiqua</i> var. <i>tenuistriata</i> V. Heurck								○				x												x	x		
<i>C. gasteri</i> var. <i>inornata</i> V. Heurck							○																				
<i>C. gasteri</i> var. <i>ornata</i> M. Peragallo											x	x															
* <i>C. arraniensis</i> Gr var. <i>tenera</i> A. Schmidt								x																			
<i>C. arraniensis</i> Greville																											
<i>C. regina</i> Johnston				x																							
<i>C. arctica</i> Cleve																											
* <i>C. inflexa</i> A. Schmidt														x													
<i>C. australis</i> Petit				○																							
<i>C. boltonis</i> Pantocsek																											
* <i>C. biflexa</i> A. Schmidt														x												x <sup>9</sup>	
<i>C. britannica</i> Nageli														x													
* <i>C. californica</i> Grunow in Cleve														x										x			
* <i>C. californica</i> var. <i>kerquelenensis</i> Hoiden														○												x	
<i>C. californica</i> var. <i>antarctica</i> Franguelli & Orlando																				(○)							
<i>C. ceticola</i> Nelson															x					x							
* <i>C. chareati</i> M. Peragallo										○																	
* <i>C. costata</i> Gregory			x				x				x	x	x							x				x			
<i>C. costata</i> var. <i>typica</i> Cleve																											
<i>C. costata</i> var. <i>antarctica</i> Mangum																				○							
<i>C. costata</i> var. <i>hexagona</i> Grunow in V. Heurck																								x		x	
* <i>C. costata</i> var. <i>kerquelenensis</i> (Petit) Cleve								x						x									x	x			
<i>C. extravagans</i> Jamisch						x		x						x						x							
* <i>C. kerquelenensis</i> Petit						○					x																
* <i>C. imperatrix</i> var. <i>kerquelenensis</i> (Petit) M. Peragallo																										x <sup>9</sup>	
<i>C. crux</i> Eizenberg																										x <sup>9</sup>	
( <i>C. curvirostrata</i> Tempère & Brun)														x													
<i>C. cyclophora</i> Grunow																											
* <i>C. cyclophora</i> var. <i>kerquelenensis</i> Cleve														x													







Table III: References of the works corresponding to the numbers quoted in Table IV.

N°	Area	Reference
	<b>Fresh water</b>	
1	Kerguelen, cap Horn	(Ehrenberg 1854)
2	Kerguelen	(Bourrelly and Manguin 1954)
3		(Thomas 1965 in Prescott 1979)
4	Antarctic, Kerguelen	(Hirano 1965 in Prescott 1979)
5	Kerguelen -soil-	(Larson 1974 in Prescott 1979)
6	Kerguelen	(Le Cohu and Maillard 1983)
7	Deception Island, Antarctica	(Zhu 1989)

Table IV: References of *Cocconeis* in fresh water Antarctic and Subantarctic areas:

Species are listed following VanLandingham (1968, 1979).

In bold italics: valid name in VanLandingham (1968)

In brackets: species not referred to in VanLandingham (1968)

In italics: species quoted as uncertain or badly defined in VanLandingham (1968)

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+ = present; O = quoted as new by the author; # = Kerguelen Islands

? = annotation of the author

	1	2	3	4	5	6	7
* <i>C. borealis</i> Ehrenberg	?+						
* <i>C. costata</i> Gregory				+			+
* <i>C. costata</i> var. <i>kerguelensis</i> (Petit) Cleve							+
<i>C. distans</i> var. <i>minima</i> H. Peragallo				+			
<i>C. fasciolata</i> (Ehrenberg) Brown							
* <i>C. costata</i> var. <i>pacifica</i> (Grunow) Cleve				+			+
* <i>C. feuerbornii</i> Hustedt						+	
** <i>C. kerguelensis</i> Manguin		O		+	+		
<i>C. litigiosa</i> V. Heurck				+			
* <i>C. pediculus</i> Ehrenberg				+		+	
* <i>C. placentula</i> Ehrenberg			+	+	+	+	
* <i>C. placentula</i> var. <i>lineata</i> (Ehrenberg) V. Heurck				+	+		
<i>C. lineata</i> Ehrenberg	+						
* <i>C. scutellum</i> Ehrenberg		+		+		+	
* <i>C. scutellum</i> var. <i>ampliata</i> Grunow						+	
* <i>C. striata</i> Ehrenberg		+					
*( <i>C. therezieni</i> Le Cohu & Maillard)						O	
<i>C. wienckensis</i> Petit			+				

\*\* *C. kerguelensis* Manguin has been transferred to the genus *Achnanthes*, see text.